Ojo Caliente Spa North Project 19-03

Pre-treatment Monitoring Report

2019

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New Mexico Forest and Watershed Restoration Institute

conserving natural resources for our future

Taos Soil & Water Conservation District

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Acronyms and Abbreviations

Acronym, Abbreviation, or Term	Explanation or Definition as used by NMFWRI
BBIRD plots	Breeding Biology Research and Monitoring Database, larger circular plot types
BEMP plots	Bosque Ecosystem Monitoring Program, small rectangular plot types
FSA	Farm Service Agency, a department of the USDA
GIS	Geographic Information Systems
GRGWA	Greater Rio Grande Watershed Alliance
LIDAR	Light detecting and ranging, a remote sensing technique using light to gather elevation data
NAIP	National Agriculture Imagery Program (aerial imagery)
NDVI	Normalized Difference Vegetation Index; GIS term for a band ratio of the visible red and the near infrared spectral bands and is calculated using the following formula: (NIR – Red)/(NIR+Red)
NHNM	Natural Heritage New Mexico
NMDGF	New Mexico Department of Game and Fish
NMED SWQB	New Mexico Environment Department Surface Water Quality Bureau
NMFWRI	New Mexico Forest and Watershed Restoration Institute
NMHU	New Mexico Highlands University
NMRAM	New Mexico Rapid Assessment Method, version 2.0
NRCS	Natural Resource Conservation Service
PC	Plot center
RGIS	Resource Geographic Information System
SWCD	Soil and Water Conservation District
TIFF	Tagged image file format
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WQCC	Water Quality Control Commission
WSS	Web Soil Survey, a soils database of the NRCS

Purpose of Report

This report covers the low-intensity and high-intensity pre-treatment vegetation monitoring assessment performed on a non-native phreatophyte removal project submitted for the Ojo Caliente Spa to the Greater Rio Grande Watershed Alliance in 2019.

Ojo Caliente Spa North Project

This 49.2-acre project was proposed in 2019 and is sponsored by the Taos Soil and Water Conservation District. According to the 2019 Request for Proposals, the project is an initial treatment of Russian olive, salt cedar and sapling to pole sized Siberian elms within Ojo Caliente Spa land along both banks of the Rio Ojo Caliente and small open water ponds. The project goals are to reduce hazardous fuels and the risk of fire, complement an adjacent GRGWA project, promote native species, enhance a wildlife corridor and promote long-term watershed health. Project maintenance, likely via herbicide re-treatment efforts, will be necessary. In addition, noxious weeds including perennial pepper weed are present near the project and will require monitoring and control by the landowner and the Taos SWCD.

Pre-treatment monitoring was conducted on October 29, November 6, and November 7, 2019. Five monitoring plots were collected on-site during pre-treatment monitoring using the protocols outlined in Appendix IV. Plot coordinates and other project geospatial data can be found in Appendix I.

2019 New Mexico Forest and Watershed Restoration Institute Personnel Involved in Fieldwork & Data Analysis:

- Carmen Briones, Monitoring Specialist & Field Supervisor (fieldwork)
- Raymundo Melendez, Monitoring Specialist & Field Supervisor (fieldwork)
- Iman Chudnoff, Monitoring & Data Technician (fieldwork)
- Karlee Rogers, Monitoring & Data Technician (fieldwork)
- Kathryn R Mahan, Ecological Monitoring Specialist (data entry & analysis)
- Louis Rymalowicz, NMHU Intern (data entry)
- Dorian Miranda, NMHU Intern (data entry)

Site Description

The site is located around 6200 ft elevation. Monitoring plots had an average of 5% slope with south and west aspects. The average precipitation for the Rio Chama region receives from 9.8 inches at Abiquiu Dam to 21.3 inches in Chama. Winter precipitation comes from snow, especially on the northern part of the area, and summer precipitation comes and goes from intense thunderstorms. Long term annual average temperature is 43˚ Fahrenheit at the Chama weather station and 51˚ Fahrenheit at the Abiquiu Dam station (U.S. Climate Data, 2017).

According to the NRCS Web Soil Survey, the project area is comprised of 91% Fluvents, nearly level, 7% Royosa loamy sand, 1 to 8 percent slopes, 1% Sedillo-Orthents association, strongly sloping and 1% Florita-Rock outcrop complex, 15 to 45 percent slopes. On-plot soil data classes the site as 26% Loam, 21% Loamy Sand, 21% Sandy Loam, 11% Sand, 11% Clay Loam, 5 % Silt Loam and 5% Silty Clay Loam. Rangeland ecological sites within this project include R036XB132NM Gravelly Hills, R035XG114NM Gravelly, R048AY003NM Mountain Valley, R036XB008NM Meadow, R051XA009NM Malpais, R051XA004NM Gravelly Loam, R036XB006NM Loamy, R036XB011NM Sandy, R036XA004NM

Gravelly Slopes, and R051XA006NM Breaks. Forestland ecological sites include F036XB133NM Pinyon-Juniper/Skunkbush Sumac (USDA NRCS, 2020).

The Gravelly Hills ecological site typical plant community consists of sideoats and black grama grasses. Shrubs include Bigelow sagebrush, broom snakeweed, longleaf ephedra, feather dalea and yucca. Sparse stands of piñon-juniper may be widely scattered across the site. Overgrazing may cause loss of grass cover allowing piñon and juniper seedlings to establish and facilitate piñon/juniper encroachment (USDA NRCS n.d.).

The Gravelly ecological site type typically supports grassland with minor shrub and piñon-juniper components. Common dominant grass species include blue, black and sideoats grama, little bluestem, spike muhly, Western wheatgrass, New Mexico feathergrass, Indian ricegrass, and squirreltail. Common shrubs include fourwing saltbush, winterfat, Apache plume, rabbitbrush, soapweed yucca, sagebrush and broom snakeweed. The site can also be found in a shrub-encroached state dominated by rabbitbrush and blue grama; erosion is more common in this state (USDA NRCS n.d.).

The Mountain Valley rangeland ecological site type is located in mountain valleys in the ponderosa pine zone. Vegetation is impacted by slope (steeper slopes are less productive), elevation, aspect, and mountain winds (increasing moisture losses). Forage availability also fluctuates with yearly summer and winter moistures and can be highly variable. Soil textures are loamy. Vegetation is primarily grasses such as mountain muhly, Arizona fescue, mountain brome, pine dropseed, western wheatgrass, blue grama, little bluestem, needle and thread. Scattered ponderosa pine, shrubs such as oak and snowberry, and forbs such as iris, coneflower, and violet may be present. (USDA NRCS, n.d.)

The Meadow ecological site type contains approximately 90 to 95 percent vegetation suitable for grazing or browsing. However, due to the high availability of soil moisture, which results in early green up and high productivity, this site is subject to deterioration by overgrazing and trampling. Deterioration is indicated by a decrease in western wheatgrass, tufted hairgrass, brome spp, and bluegrass with an increase in mat muhly, sedges, rushes, and forbs (USDA NRCS n.d.).

The Malpais ecological site type typically has shallow soils with large amounts of exposed bedrock. The vegetative community is a grassland-shrub mixture including grasses such as muhly, wolftail, threeawn, gramas, shrubs such as big sagebrush, rubber rabbitbrush, and forbs such as sunflowers, silverleaf nightshade, daisies, Rocky Mountain beeplant, threadleaf groundsel, locoweed, penstemon, asters, gilias and globemallows. (USDA NRCS, n.d.)

The Gravelly Loam rangeland ecological site type is found on benches, hills, and ridges. The soil texture is very gravelly. The site is dominated by grassland vegetation and scattered shrubs. Common grasses include western wheatgrass, Indian ricegrass, needle and thread, sideoats grama, blue grama, squirreltail, and sand dropseed. Shrubs include Ericaceae (heath) and fourwing saltbush. (USDA NRCS, n.d.)

The Loamy ecological site is a grassland site with scattered shrubs throughout. Forbs are a minor component. Dominant species may include sideoats grama, sand dropseed, pine dropseed, mat muhly, cheatgrass, pingue, wooly Indianwheat, globemallow, prairie coneflower, oneseed juniper, piñon, pale wolfberry, broom snakeweed, yucca, cholla cactus and antelope bitterbrush (USDA NRCS n.d.).

The Sandy ecological site type is typically mixed-grass and shrub. Fourwing saltbush and winterfat are the dominant shrubs with big sagebrush and rabbitbrush occurring in lesser amounts. Few, if any, trees occur on this site. Forbs are a minor component except during spring (USDA NRCS n.d.).

The Gravelly slopes ecological site is usually mixed grasses and shrubs including needlegrass, Indian ricegrass, western wheatgrass, sideoats grama, galleta, blue grama, dropseed spp, threeawn, fourwing saltbush and winterfat. Piñon/juniper trees may also be present in small amounts. Continuous grazing has been observed to shift the species balance to less desirable grasses and woodies (USDA NRCS n.d.).

The Breaks rangeland ecological site is found along canyon edges, ridges and benches, for example, almost the Rio Grande Gorge. Soil textures are gravelly loam, stony clay loam, and cobbly. The site climax community is a mixture of grasses (e.g. grama, ricegrass, needle and thread, feathergrass, galleta), forbs (such as aster, Indian paintbrush, fleabane, and buckwheat) and shrubs (such as big sagebrush, fourwing saltbush, winterfat, oak, currant, and Apache plume). “Scrubby” oneseed juniper and pinyon pine may be present in minor quantities depending on the exposure. (USDA NRCS, n.d.)

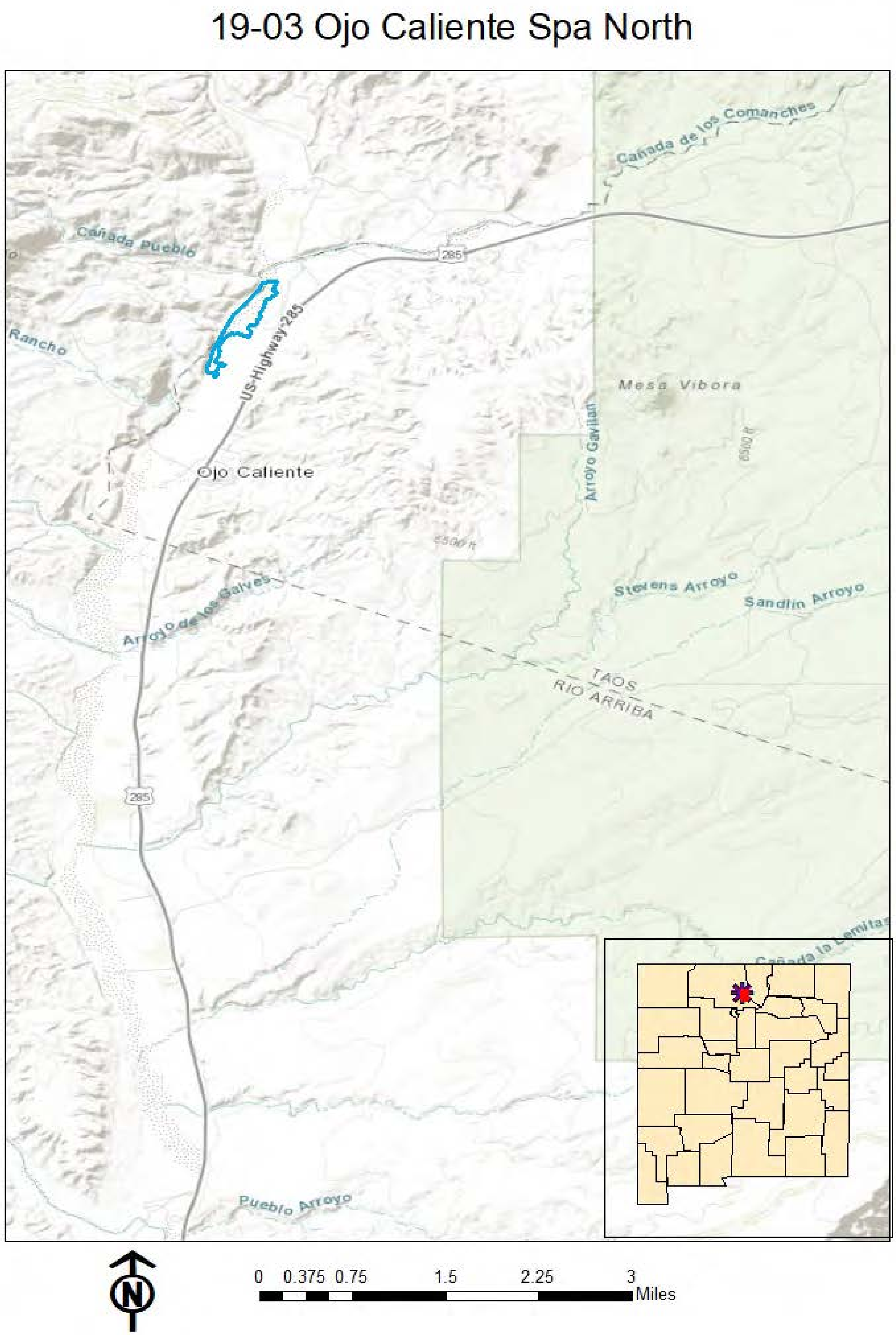

Figure 1. Project 19-03 in geographic context.

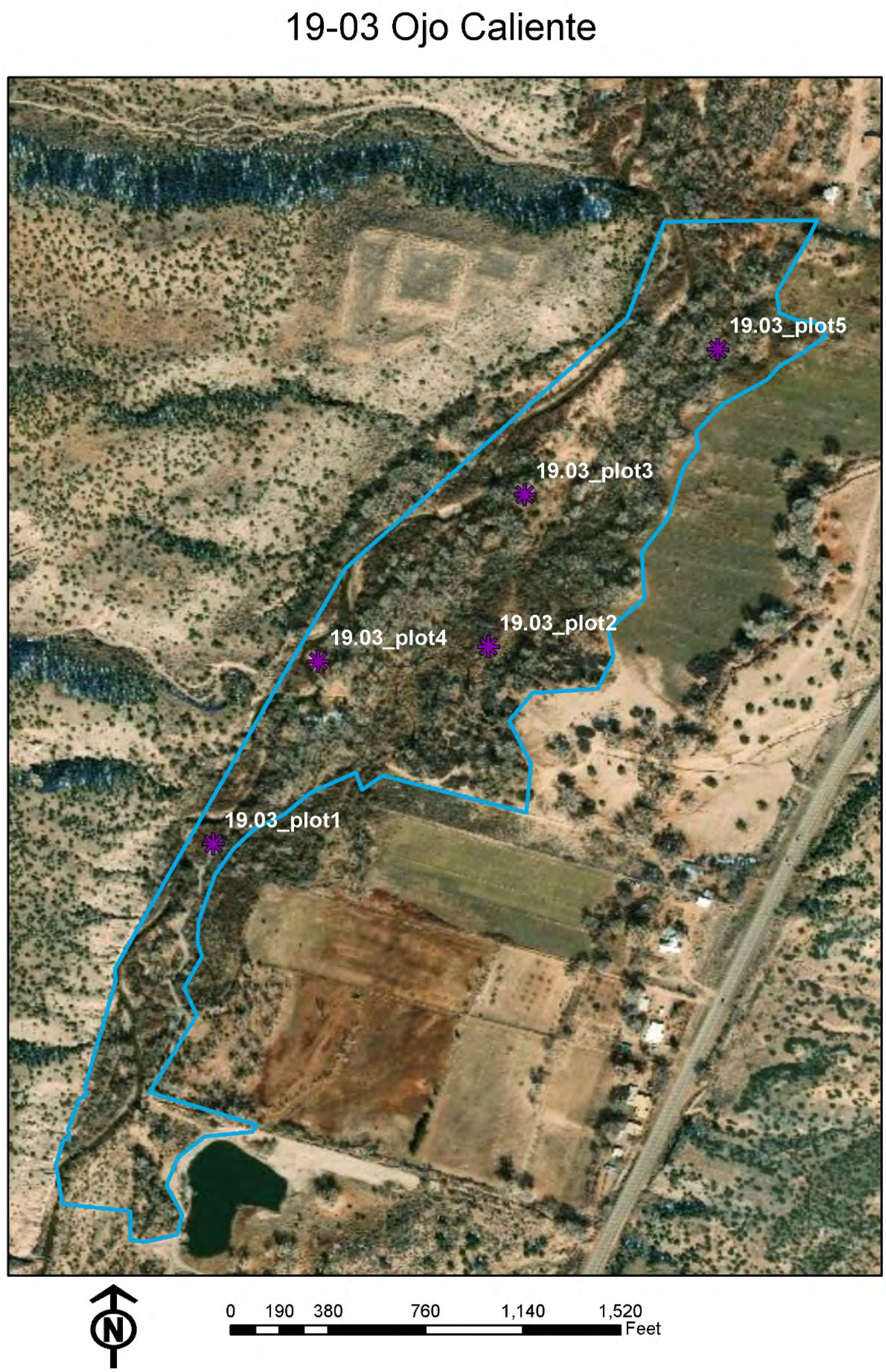

Figure 2. 19-03 Ojo Caliente Spa North project outline.

Pre-Treatment Monitoring

Tree Component

The plots on site were characterized as Hink and Ohmart Type 1, 3 and 5 (modified types 1 and 5). This indicates a vegetative vertical structure of overstory and understory, as well as tall shrub stands.

The site had an average of 83% overstory canopy cover collected by densiometer. There was an average of 42 trees (over 5 inches at DBH) per acre. These trees were 43% Russian olive (18 trees per acre), 29% oneseed juniper (12 trees per acre), 24% cottonwood (10 trees per acre), and 5% salt cedar (2 trees per acre). The quadratic mean diameter (QMD) for all trees was 13.7 inches, and average basal area per acre was 135 square feet. Average overall tree height was 41 feet, and average live crown base height was 5.2 feet. There were also 4 snags per acre, 50% oneseed juniper and 50% Siberian elm.

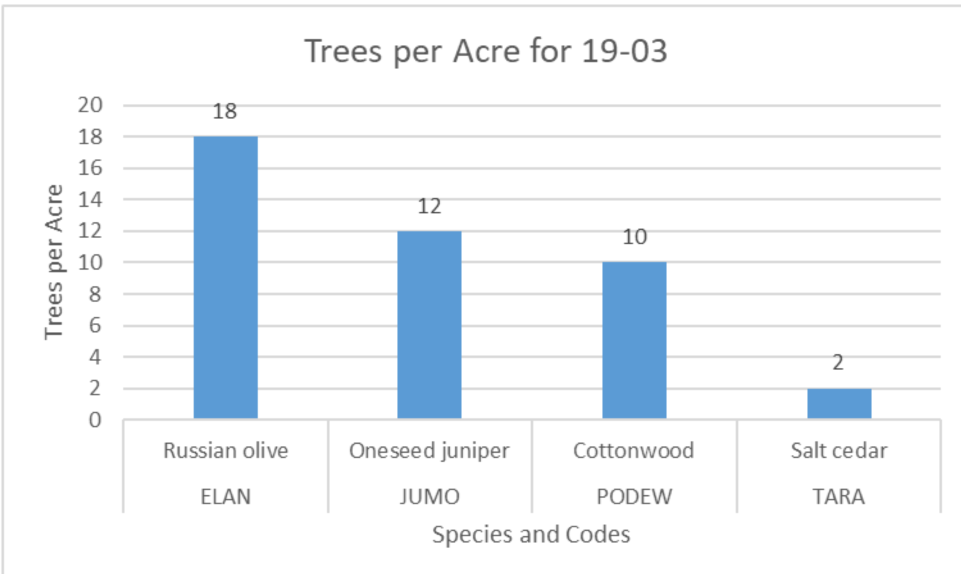

Figure 3. Trees per Acre.

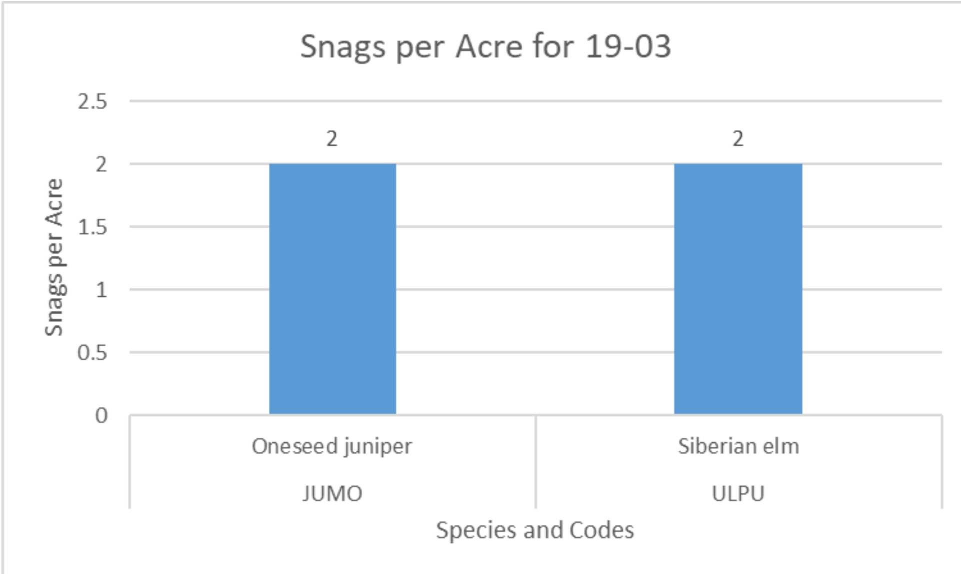

Figure 4. Snags per Acre

Live tree seedlings were recorded at 480 individuals per acre, of which 88% (420 seedlings per acre) were salt cedar, 8% (40 seedlings per acre) Russian olive, and 4% (20 seedlings per acre) were Siberian elm. There were also 40 dead seedlings per acre recorded, all of which were Russian olive (not shown on chart).

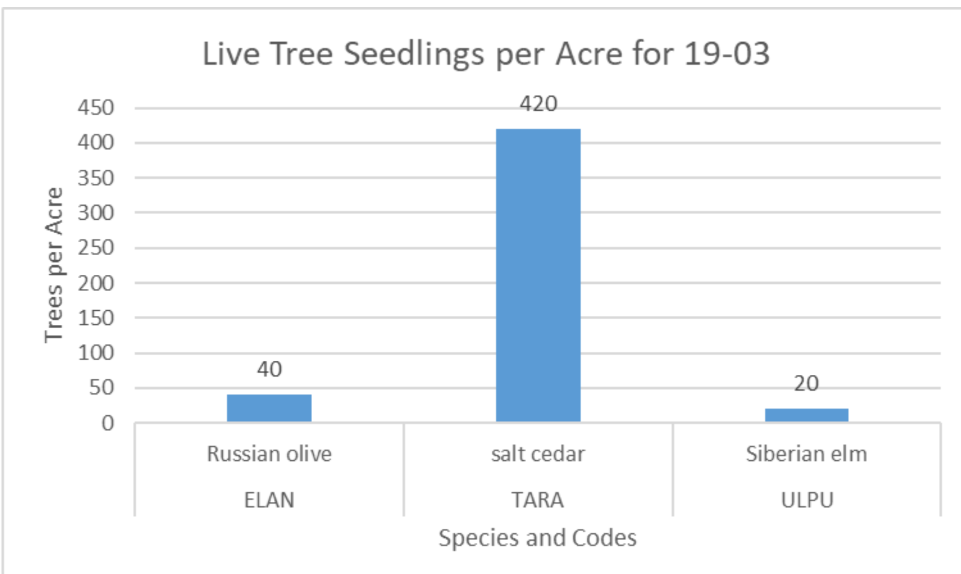

Figure 5. Live tree seedlings per acre

In addition, 5080 live shrubs per acre, and 600 dead shrubs per acre were recorded in both seedling and sapling classes (details in figure below).

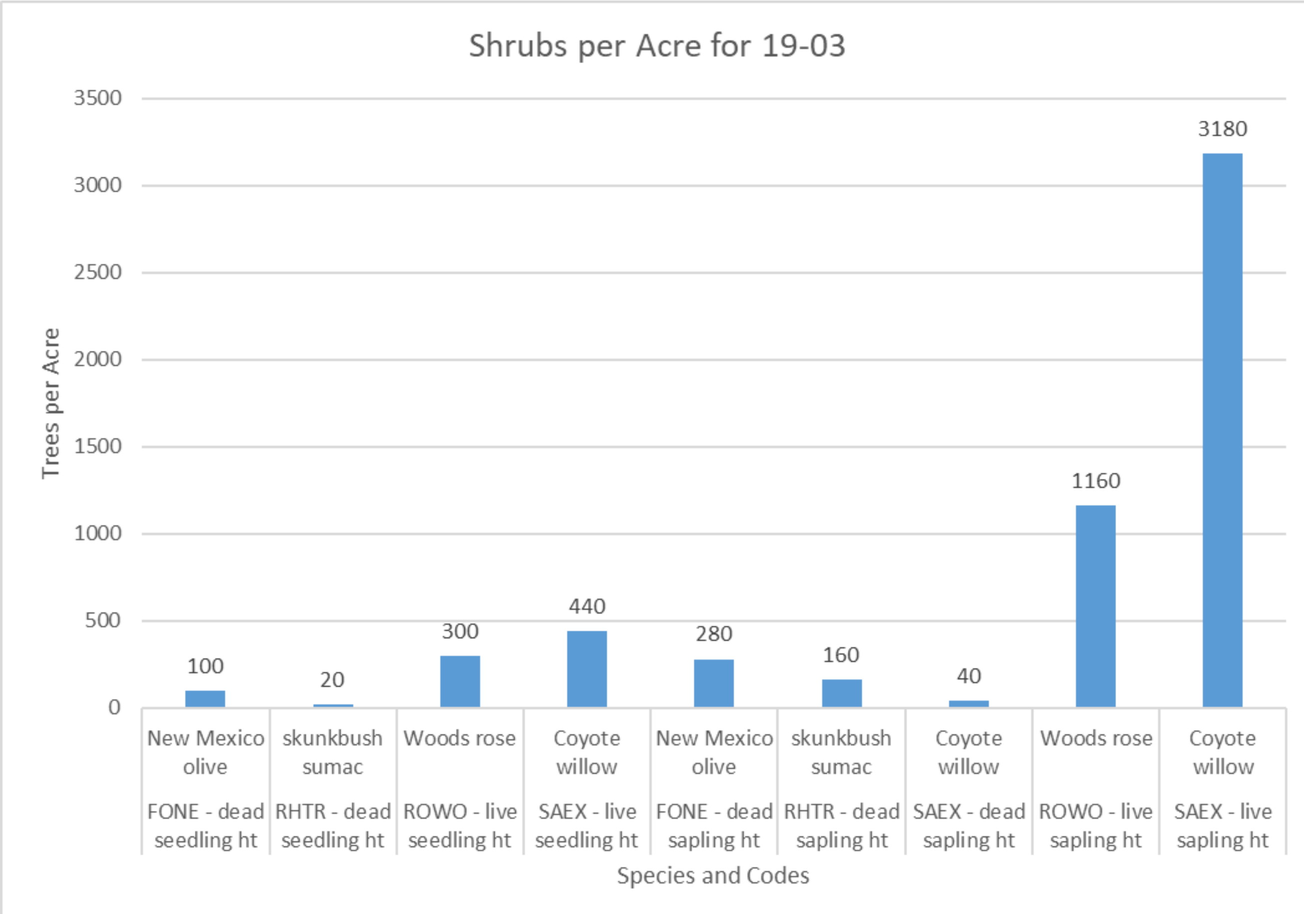

Figure 6. Shrubs per acre by species for 19-03.

There were 840 live tree saplings per acre: 76% salt cedar (640 per acre) and 24% Russian olive (200 per acre). There were also 40 dead Russian olive saplings per acre recorded on plots.

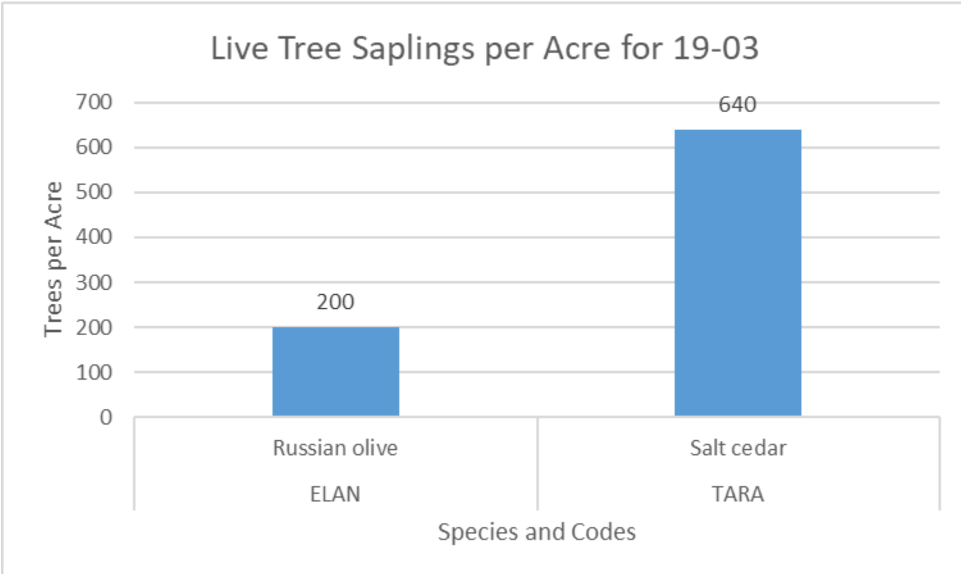

Figure 7. Live saplings per acre.

Understory and Ground Cover

Overall aerial cover by vegetative lifeform averaged 58% tree, 49% shrub, 39% forb/herb, 97% graminoid, and 0.4% cactus. Tree species recorded on plots were oneseed juniper (*Juniperus monosperma)*, Russian olive (*Elaeagnua angustifolia)*, cottonwood (*Populus deltoides*), salt cedar (*Taramix ramosissima*) and Siberian elm (*Ulmus pumila*). Shrub species included New Mexico olive (*Forestiera neomexicana*), currant (*Ribes sp.*), Wood's rose (*Rosa woodsii*), coyote willow (*Salix exigua*), and skunkbush sumac (*Rhus trilobata*). Forb/herb species included two asters (*Aster sp.*), bull thistle (*Cirsium vulgare*), prickly lettuce (*Lactuca serriola*), alfalfa (*Medicago sp.*), woolly plaintain (*Plantago patagonica*), Pennsylvania smartweed (*Polygonum pensylvanicum*), curly dock (*Rumex crispus*), false hellebore (*Veratrum sp.*), and unidentified forbs. Graminoid species included cheatgrass (*Bromus tectorum*), orchardgrass (*Dactylis glomerata*), saltgrass (*Distichlis spicata*), western wheatgrass (*Pascopyrum smithii*), broadleaf cattail (*Typha latifolia*), sand dropseed (*Sporobolus cryptandrus*) and unidentified grasses. Cactus species present included pricklypear (*Opuntia phaeacantha*).

Aerial cover for entire 1/10th acre plot					
Tree	**Shrub**	**Forb/Herb**	**Gramanoid**	**Cactus**	**Other (bryophyte, saprophyte)**
58%	49%	39%	97%	0.4%	0.0%

Ground cover on plots was an average of 34% plant basal cover, 33% litter, 15% bole, 9% rock, 4% water, 3% bare soil, and 1% gravel.

Ground cover for entire 1/10th acre plot						
Plant Basal	**Bole**	**Litter**	**Bare Soil**	**Rock**	**Gravel**	**Water/ Wet Soils**
34%	15%	33%	2.8%	9.4%	1.2%	4.0%

Surface Fuels

Surface fuels on site averaged 15.9 tons of total wood fuels per acre, and a fuelbed depth of 1.5 inches.

19-03 Pre-Treatment	
Fuel	**Tons/Ac**
1-Hour	0.1
10-Hour	1.43
100-Hour	0.5
1000-Hour	13.83
Duff	2.91
Litter	6.03
TOTAL FINE WOOD FUELS	2.03
TOTAL WOOD FUELS	15.86
TOTAL SURFACE FUELS	24.8
Fuelbed Component	**Depth (inches)**
Duff	0.29
Litter	1.21

Comments and field crew observations

Site has a stream and active floodplain with a high water table. Cottonwoods had bird nests during site visit. There were thick willow and grass stands as well as areas with invasives, bare sand and gopher holes.

Conclusions & Plans going forward

The same plots should be re-measured five years post-treatment to monitor the success of treatment in effecting long-term change. It is our intention and expectation that the data collected in these intervals will reflect any significant changes in disturbance and ecological function of the site. The water on site will likely support heavy re-sprouts, and treatment maintenance will be key.

Personnel Involved

2019 New Mexico Forest and Watershed Restoration Institute Personnel:

- Carmen Briones, Monitoring Specialist & Field Supervisor (fieldwork)
- Raymundo Melendez, Monitoring Specialist & Field Supervisor (fieldwork)
- Iman Chudnoff, Monitoring & Data Technician (fieldwork)
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- Kathryn R Mahan, Ecological Monitoring Specialist (data entry & analysis)
- Louis Rymalowicz, NMHU Intern (data entry)
- Dorian Miranda, NMHU Intern (data entry)
- Joe Zebrowski, GRGWA Technical Committee Chair (technical support)
- Patti Dappen, GIS Specialist (technical support)

Other persons contacted:

- Rolf Annon, representative of Ojo Caliente Spa (landowner)

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Appendix I – Photopoint and Plot Coordinate Table

Name	Latitude	Longitude
19.03_1_NESW	36.31796876	-106.04296170
19.03_2_NESW	36.32011497	-106.03999117
19.03_3_NESW	36.32175976	-106.03960374
19.03_4_NESW	36.31997198	-106.04182881
19.03_5_NESW	36.32330855	-106.03751879

Appendix II – Photos

Ojo Caliente 19.03_1_N

Ojo Caliente 19.02_1_N
taken 11’.9 from PC

Ojo Caliente 19.03_1_E

Ojo Caliente 19.03_1_E
taken 11’.9 from PC

Ojo Caliente 19.03_1_S

Ojo Caliente 19.03_1_S
taken 11’.9 from PC

Ojo Caliente 19.03_1_W

Ojo Caliente 19.03_1_W
taken 11'.9 from PC

Ojo Caliente 19.03_1_BR_302°
taken 75' from Plot Center
looking toward Plot Center

Ojo Caliente 19.03_1_BR_112°
taken 75’ from Plot Center
looking toward Plot Center

Ojo Caliente 19.03_1_C
taken 75’ North from Plot
Center looking toward Plot
Center

Ojo Caliente 19.03_2_N

Ojo Caliente 19.03_2_E

Ojo Caliente 19.03_2_S

Ojo Caliente 19.03_2_W

Ojo Caliente 19.03_2_BR_232°
taken 75’ from Plot Center
looking toward Plot Center

Ojo Caliente 19.03_2_BR_178°
taken 75’ from Plot Center
looking toward Plot Center

Ojo Caliente 19.03_2_C
taken 75’ North from Plot
Center looking toward Plot
Center

Ojo Caliente 19.03_3_N

Ojo Caliente 19.03_3_E

Ojo Caliente 19.03_3_S

Ojo Caliente 19.03_3_W

Ojo Caliente 19.03_3_BR_128°
taken 75’ from Plot Center
looking toward Plot Center

Ojo Caliente 19.03_3_BR_128°
taken 75’ from Plot Center
looking toward Plot Center

Ojo Caliente 19.03_3_C taken 75' North from Plot Center looking toward Plot Center

Ojo Caliente 19.03_4_N

Ojo Caliente 19.03_4_E

Ojo Caliente 19.03_4_S

Ojo Caliente 19.03_4_W

Ojo Caliente 19.03_4_BR_148°
taken 75’ from Plot Center
looking toward Plot Center

Ojo Caliente 19.03_4_BR_130° taken 75' from Plot Center looking toward Plot Center

Ojo Caliente 19.03_4_C taken 75' North from Plot Center looking toward Plot Center

Ojo Caliente 19.03_5_N

Ojo Caliente 19.03_5_E

Ojo Caliente 19.03_5_S

Ojo Caliente 19.03_5_W

Ojo Caliente 19.03_5_BR_140°
taken 75’ from Plot Center
looking toward Plot Center

Ojo Caliente 19.03_5_BR_284°
taken 75’ from Plot Center
looking toward Plot Center

Ojo Caliente 19.03_5_C
taken 75’ North from Plot
Center looking toward Plot
Center

Appendix III – Ecological Context of Bosque Restoration

Neither the challenges nor the importance of working in the bosque and other riparian areas in New Mexico today should be underestimated. According to the New Mexico Department of Game and Fish Conservation Division, wetlands and riparian areas comprise approximately 0.6 percent of all land in New Mexico (2012). Despite this small percentage, estimates of New Mexican vertebrate species depending on wetland and riparian habitat for their survival ranges from 55% (New Mexico Department of Game and Fish Conservation Services Division, 2012) to 80% (Audubon New Mexico, 2013). These areas also provide flood mitigation, filtration of sediment and pollutants, and water for a variety of purposes including groundwater recharge (Audubon New Mexico, 2013). In addition, native vegetation such as cottonwoods have cultural significance to many communities.

As much as these areas are disproportionately important to ecosystems and human communities, they are equally disproportionately impacted by disturbance. Anthropogenic impacts with major consequences for our riparian areas include dams, reservoirs, levees, channelization, acequias and ditches, jetty jacks, riprap and Gabion baskets, urbanization, removal of native phreatophytes, grazing by domestic livestock, excessive grazing pressure by native ungulate populations absent natural predation cycles, beaver removal, logging, mining, recreation, transportation, introduction and spread of invasive exotic species, groundwater extraction, altered fire and flood regimes drought and climate change (Committee on Riparian Zone Functioning and Strategies for Management, et al., 2002). Statewide, it is estimated that as much as 90% of New Mexico's historical riparian areas have been lost (Audubon New Mexico, 2013), and approximately 39% of our remaining perennial stream miles are impaired (New Mexico Department of Game and Fish Conservation Services Division, 2012).

New Mexico *is* fortunate enough to have the Middle Rio Grande Bosque, the largest remaining bosque in the Southwest (USDA USFS, 1996). However, over the past two decades, the number of fires in the bosque has been increasing. Historically, the primary disturbance regime in the bosque has been flooding, not fire, which means the system is not fire-adapted. In fact, native species like cottonwood resprout from their roots after floods and need wet soils to germinate from seed. Flooding also promotes decomposition of organic material and keeps the soil moist which reduces the likelihood of fire. Today, overbank flow is uncommon in many areas of the Rio Grande due to the heavy alteration of the channel and flow regimes (two obvious examples are the structures defining the upper and lower extent of the Middle Rio Grande: Cochiti Dam and Elephant Butte Reservoir). This has led to low fuel moisture content and high fuel loads, as well as increased human presence in the riparian area. As a result, bosque fires are more common and more severe: they kill cottonwoods and other native species, creating spaces which are filled by non-native species such as salt cedar, Russian olive, Siberian elm, and Tree-of-Heaven. We are constantly learning more about how these species can exploit and encourage a riparian fire regime, in addition to many other changes they bring to ecosystems.

Efforts geared toward the removal of these nonnative species can help to reduce fire risk, preserve native vegetation, and be part of a larger effort to restore the bosque and the watershed as a whole to a more natural and functional ecosystem. The Greater Rio Grande Watershed Alliance (GRGWA) has been working on these issues with a variety of collaborating organizations and agencies within the Rio Grande basin for several years. Since 2013, the New Mexico Forest and Watershed Restoration Institute (NMFWRI) has been working with GRGWA and the Claunch-Pinto Soil and Water Conservation District (SWCD) to begin construction of a geodatabase for all of GRGWA's non-native phreatophyte removal projects as well as to perform the formal pre- and post-treatment monitoring, utilizing the field methods explained below as well as LIDAR analysis where appropriate and available.

Appendix IV - Monitoring and Field Methods

NMFWRI Riparian CSE-Based Plot Sample Protocols

These monitoring protocols were instituted in 2019 as standard for all GRGWA projects. These are based on the 2011 Guidelines and Protocols for Monitoring Riparian Forest Restoration Projects (Bonfantine, et al.) and the Common Stand Exam-based protocols used by NMFWRI for CFRP projects. For questions or comments, contact Kathryn R Mahan, Ecological Monitoring Specialist, NMFWRI.

Crews, Navigation & Plot Setup

Plots are most efficiently accomplished with a **3-person crew** but can also be taken with 2 people. More detailed plots, presented here as options, are most efficient with a 4- to 5-person crew. All crews need basic knowledge of monitoring methods and rationale, equipment, plant species and common tree pests and diseases.

Plots are established using a random point location with project-specific boundaries e.g. stand boundaries, treatment areas, vegetation types, etc. In our office, maps and plot locations are generated with ArcGIS utilities and are loaded onto a Trimble and Garmin GPS units. **The sampling density scheme** for GRGWA projects is as follows:

Projects under 21 acres – 2 plots
21-50 – 1 plot per 10 acres
For projects 51+ acres:
51-70 ac --- 5 plots
71-90 ac --- 6 plots
91-110 ac --- 7 plots
111-200 ac --- 8-9 plots
201-400 ac --- 10 plots
400+ ac – discuss alternate sampling methods (e.g. LiDAR)

The plot minimum spacing is 300 ft on most projects, or 200 or 100 ft on projects where a 300 ft spacing will not allow the prescribed number of plots to fit within boundaries. Plots must be a minimum of 50 ft from project boundary. Plots will be moved in a random direction towards the inside of project if plot lands less than 50 ft of boundary using "Create Random Points" in ArcMap. **Note that within this framework, flexibility exists to add plots as needed to capture site diversity.**

Unit maps, driving maps and driving directions are created and sent with the field crew. Once in the project area, **navigation** to a plot is typically accomplished through paper maps and the Garmin GPS units. Paper maps can be easily marked with Sharpies to indicate sequence of plot collection, dates, and teams at work; this information can be stored with the datasheets and may help answer questions that arise later. We use Garmin GPS units because they are user-friendly and can run on AA batteries which are easily replaced in the field. We use the Trimble unit to more accurately determine plot location and collect updated plot location coordinates which can later be post-processed for greater location accuracy with GPS Pathfinder Software. Plots must be moved one chain (66 ft) at a random azimuth from their original, intended location if they are within 75 feet of a road.

A marker (we typically use a 1-foot piece of ½ inch rebar with a mushroom cap) is installed at plot center if the landowner/manager gives permission. Markers should be low to the ground and well flagged so that they are obvious to managers and treatment contractors. Where plots are being re-visited, a good metal detector may be of use to locate the center stake. Copies of the previous plot photos can also be useful.

Plots are set up using 8 pin flags in addition to the center stake. Crew members walk cardinal azimuths (N, E, S, W) from plot center and place pin flags at **11.78ft (11' 9") and 37.24ft (37' 3")** to give visual aids for the two plots (1/10th ac and 1/100th ac) whose purposes are described below.

Photographs, Witness Trees & Other Plot data

Eight **photographs** are taken per plot. If more than the two standard Brown's transect is collected, additional photographs are taken in the same format. Typically, a white board with marker is used to tag each photo. The first photo taken at each plot is of the white board on the ground at plot center ("PC"). This ensures the data technicians are able to read the plot name and number and correctly identify the photos that follow. It is helpful if the camera used can record GPS coordinates.

Additional photos include:

- "C," taken from 75 feet along the North azimuth looking at a crew member holding the white board at plot center
- Brown's transect photo, "B_*degrees*" taken from the 75-foot mark of each fuels azimuth looking towards a crew member holding the white board at plot center
- "N," "E," "S," and "W" photos taken from plot center facing a crew member holding the white board 37.2' at each of the four cardinal azimuth flags. Additional photographs may be taken, but we recommend these be taken after the mandatory eight plot photos, and noted on the data sheets, so that there is no confusion for the data technicians.

All plot photos except "PC" and Brown's transect photos need to be documented in the **Photopoint Log**. The Photopoint Log provides places to document landmarks and other information about each photograph to make re-takes simpler.

Photo order, hill slope, dominant aspect, coordinates, elevation, date, and **time** are recorded for each plot. **Comment fields** are available on all datasheets and we encourage all observations, including species, land use impacts, fire history, challenges in taking plot, etc. to be documented here.

A **witness tree** or trees should be near plot center to assist with finding plot center and ideally should be expected to survive any future thinning, fire, or other disturbance. For example, mature yellow-bark pines near plot center are easy to find and not likely to be thinned. Any healthy tree will work. The tree should be flagged, noted in the overstory data, and described on the Plot Description datasheet.

Overstory

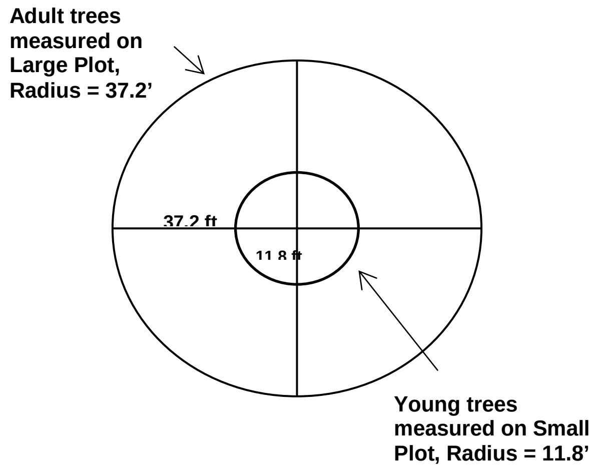
All **trees and snags** are measured within the 1/10th acre plot (37.24 ft. radius) circular, fixed area sample plot. We typically define a tree as ≥ 4.5 ft. and > 5 in DBH or DRC, although other cutoffs may be used depending on objectives. Species, condition, DBH or DRC, number of stems, total height, and live crown base height are recorded for each tree located within the plot. Most trees are measured at DBH with exception of *Quercus* spp., *Juniperus* spp. or *Pinus edulis* species with more than two stems at DBH. Be aware that other trees/large shrubs with multiple stems, such as saltcedar, Russian olive, mountain mahogany or chokecherry, cannot be processed if they are measured at DRC since their conversion formulas are unavailable. Depending upon the project, other information may be collected including damage and severity, scorch height, snag decay class, crown ratio, and crown class. Trees are recorded starting from the north azimuth line and moving clockwise, like spokes of a wheel from plot center. In dense stands, we find it helpful to flag the first tree measured to keep the crew oriented. If appropriate, this first tree may also serve as the **witness tree**. Do not forget to flag and record your witness tree.

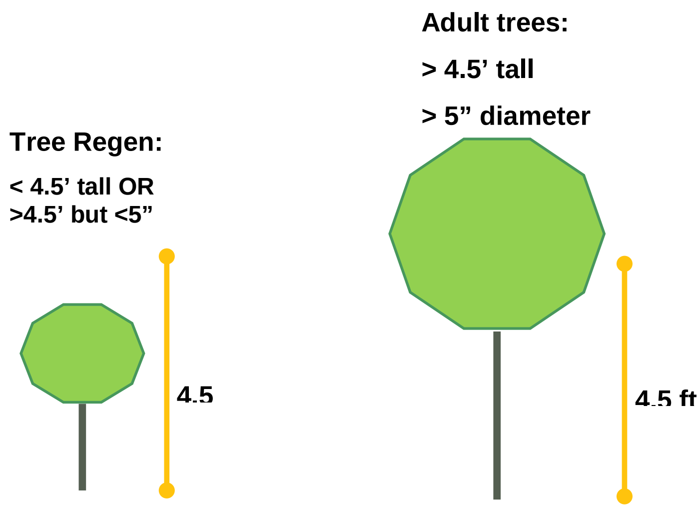
Tree regeneration is measured on the nested 1/100th acre circular plot (11.78 ft. radius) and species, condition, and height class (>0-0.5 ft; >0.5-1.5ft; >1.5-2.5ft; >2.5-3.5ft.; >3.5-4.5ft) are recorded for each **seedling** or sprout. **Saplings** (>4.5ft but <1.0in DBH/DRC) are also recorded in this way. **Shrubs** are measured on the same nested subplot and species, condition and height/diameter class are recorded for each stem just as with tree species; we typically record cacti in this category as well. Other cutoffs may be used for height and diameter classes depending upon objectives.

Trees and shrubs are typically recorded using their **USDA PLANTS code**, which is commonly a four letter code defined by the first two letters of the genus and first two letters of the species name (e.g. PIPO, ABCO, PIFL, PIED, JUDE, JUSC, QUGA, etc). Note that upon entry into a database, it is common for these codes to be followed by various numbers in order to differentiate between other species whose names would create the same code. These symbols can be found on the USDA PLANTS website, https://plants.usda.gov/

Canopy cover (density) is an average of four measurements from a spherical densiometer. These four measurements are taken facing out at the four small-plot pin flags along the perimeter of the nested subplot. In this way, each reading is spaced 90 degrees apart. Each of the four measurement is recorded separately on the datasheet. The crew should be sure to count dots, not squares, and always record the area covered, not open.

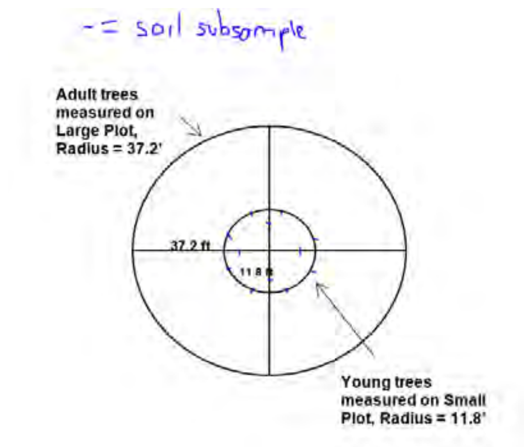
Vegetative Community Structure type is a classification system developed by Hink and Ohmart to describe patterns of vegetation specifically along the Middle Rio Grande. The **"original" Hink and Ohmart** scheme uses vegetation height and presence of understory vegetation to assign a structure type between 1 and 6. In addition, the New Mexico Environment Department developed a **"modified" Hink and Ohmart** system that assigns a value of 1, 2, 5, 6S, 6W, 6H or 7. We recommend the field crews take copies of the keys for both original and modified schemes and apply them to the entire 1/10th acre plot.


Adult trees
measured on
Large Plot,
Radius = 37.2’
37.2 ft
11.8 ft
Young trees
measured on Small
Plot, Radius = 11.8’


Adult trees:
> 4.5’ tall
> 5” diameter
Tree Regen:
< 4.5’ tall OR
>4.5’ but <5”
4.5
4.5 ft

Soils

At this time, **soil texture** is collected in four locations. At each of the four 1/100th acre cardinal direction flags, collect 3 subsamples of soil using a shovel or soil corer to a depth of 6 inches. Standing over the flag as if taking canopy cover, i.e. facing away from plot center in the cardinal direction of the flag, you will collect soil subsamples 2 feet to the left, right and immediately behind you as illustrated below.



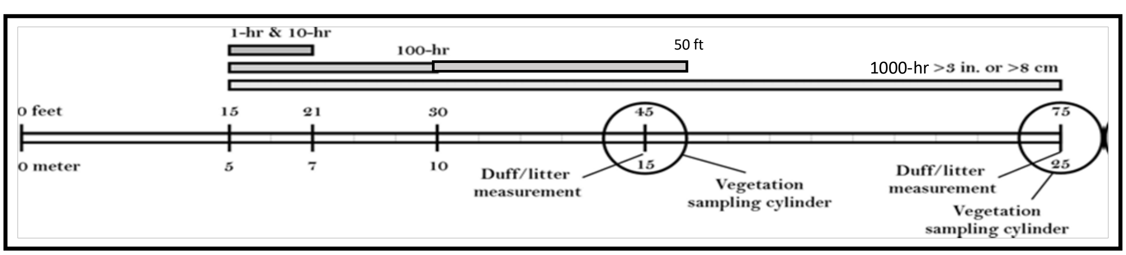
Combine each set of three subsamples into one sample by mixing thoroughly in a bag or tub. Remove any large organic debris such as plants or wood chips. Follow the soil texture flow chart to determine soil texture for each combined sample at each measurement point. Record this on the datasheet for a total of four soil textures per plot. Return soil to all holes when sampling is complete.

Fuels (Brown's)

Dead woody biomass and forest floor depth are measured using two planar Brown's transects. These are at random azimuths. To select a random azimuth, one crew member spins a compass and another decides when to stop. Typically in our protocol, a fiberglass tape is run from the plot center stake out 75 feet and fuels are measured from 15 to 75 feet to account for the expected foot traffic disturbance around plot center. Parameters measured include **1, 10, 100, and 1,000 hour fuels** ("time-lag fuels"). See diagram below for standard lengths of various transects.

For full protocol details, see Brown 1974 and subsequent guidelines or the NMFWRI training manual. Quick reminders: Note that in our protocol, a piece of coarse woody debris (CWD) must be >3" in diameter and at least 3 feet long to count as a 1000-hour fuel; if it is >3" in diameter, but under 3 feet long, we count it as a 100-hour fuel. Decay class (1 to 5) and sometimes length is collected for each 1000-hour fuel. The comment field on the datasheets is often used to record species and how the log came to be on the ground, when discernable. The sampling plane goes up to 6 ft above the transect. Rooted vegetation does not count unless it has a lean over 45 degrees.

Litter and duff depth measurements are taken at 45 feet and 75 feet on each transect.



Understory Cover

Vegetation and ground cover are estimated across the entire 1/10th acre plot. Vegetation measurements include **aerial percent cover** of seedling/saplings, shrubs (including cacti), graminoids, and forbs, and may not necessarily total 100%. Aerial percent should be further stratified by individual species greater than 1% cover. USDA PLANTS codes are preferred. The status of each group of vegetation (live, dead, sick) as well as the nativity (Native, Exotic, Both, or Unknown) should be recorded. Any unknown plants should described in comments, photographed (after plot photos!) and samples collected in a field press for subsequent identification. We strongly recommend the inclusion of sticky notes with each pressed sample describing the collection location and conditions, including the plot.

Ground cover measurements include percent cover of plant basal area (including cacti), boles, litter, bare soil, rock, gravel, and water/wet soil and must total 100%.

Data processing and reporting

At this time, we use **FFI software**, as well as Excel spreadsheets, to enter and analyze our data. FFI is able to export to FVS and FuelCalc. FFI software and User Guides are available for download here: https://www.frames.gov/partner-sites/ffi/software-and-manuals/

In order to process individual piñons, junipers and oaks with more than 2 stems or whose branch structure made access difficult and were therefore measured at root collar (DRC) instead of breast height (DBH), we use the **equations developed by Chojnacky and Roger** (1999).

All our results are typically reported to two significant digits, with exceptions for those metrics we know were measured with either more or less precision.

Sample reports can be found on our website: http://nmfwri.org/resources/restoration-information/cfrp/cfrp-long-term-monitoring/cfrp-long-term-monitoring

And

https://www.nmfwri.org/collaboration/greater-rio-grande-watershed-alliance

Appendix V - Modified Hink and Ohmart categories, from NMRAM

The following is pages 39-41 in Muldavin et al.'s 2014 NMRAM for Montane Riverine Wetlands v 2.0 Manual (draft, not yet published)

Vegetation Vertical Structure Type Definitions for NMRAM

Multiple-Story Communities (Woodlands/Forests)

Type 1- High Structure Forest with a well-developed understory.

Tall mature to intermediate-aged trees (>5 m [>15 feet]) with canopy covering >25% of the area of the community (polygon)and understory layer (0-5 m [0-15 feet]) covering >25% of the area of the community (polygon). Substantial foliage is in all height layers. (This type incorporates Hink and Ohmart structure types 1 and 3.) Photograph on Gila River by Y. Chauvin, 2012.

Type 2 -Low Structure Forest with little or no understory.

Tall mature to intermediate-aged trees (>5 m [>15 feet]) with canopy covering >25% of the area of the community (polygon) and understory layer (1-5 m [3-15 feet]) covering <25% of the area of the community (polygon). Majority of foliage is over 5 m (15 feet) above the ground. (This type incorporates Hink and Ohmart structure types 2 and 4.) Photograph on Diamond Creek by Y. Chauvin, 2012.

Single-story Communities (Shrublands, Herbaceous and Bare Ground)

Type 5 -Tall Shrub Stands.

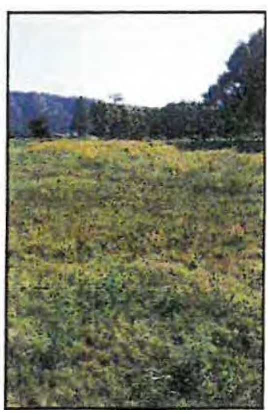
Young tree and shrub layer only (15-5 m [4.5-15 feet]) covering >25% of the area of the community (polygon). Stands dominated by tall shrubs and young trees, may include herbaceous vegetation underneath the woody vegetation. Photograph on San Francisco River by Y. Chauvin, 2012.

Type 6S-Short Shrub Stands.

Short stature shrubs or very young shrubs and trees (up to 1.5 m [up to 4.5 feet]) covering >10% of the area of the community (polygon). Stands dominated by short woody vegetation, may include herbaceous vegetation underneath the woody vegetation. Photograph on Lower Pecos River by E. Lindahl, 2008.

Type 6W-Herbaceous Wetland.

Herbaceous wetland vegetation covering >10% of the area of the community (polygon). Stands dominated by obligate wetland herbaceous species. Woody species absent, or <10% cover. Photograph of *Carex nebrascensis* meadow on upper Rio Santa Barbara by Y. Chauvin, 2009.



Type 6H-Herbaceous.

Herbaceous vegetation covering >10% of the area of the community (polygon). Stands dominated by herbaceous vegetation of any type except obligate wetland species. Woody species absent or <10% cover. Photograph on Diamond Creek by Y. Chauvin, 2012.

Type 7–Sparse Vegetation/Bare Ground.

Bare ground, may include sparse woody or herbaceous vegetation, but total vegetation cover <10%. May be natural in origin (cobble bars) or anthropogenic in origin (graded or plowed earth) Photograph on Lower Gila River by Y. Chauvin, 2012.